Current issues in infant feeding

A guide for professionals

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Foreword

In this century, technological developments have revolutionized infant feeding. Infant formulas have been designed to closely simulate human milk. Precooked infant cereals have replaced former time-consuming products. Strained solid foods are mass produced to provide an infinite variety of readily available solid foods for infants. With all these choices, some guidance appears necessary to determine which food choices most adequately meet the infant's nutritional needs.

The time of progression from human milk or formula, to whole milk and the introduction of solid foods has also changed dramatically since the turn of the century. The appropriateness of these practices will be examined in this report.

Recently, the concept of prevention has been applied to infancy, with dietary modifications being suggested to prevent later diseases of lifestyle such as obesity, heart disease and dental caries. These recommendations are reviewed to determine their validity and usefulness for the first year of life.

It is hoped that the contents of this report will be useful to physicians, nurses, nutritionists, dietitians and health professionals-in-training for their counselling of parents about infant feeding.

Types of milk feeding

Human milk

Benefits

Breast milk is the milk designed to uniquely meet the nutritional and immunological needs of the human infant. From a nutritional perspective, it is the reference standard for all milk feeding in infancy, and to date it has not been replicated by any commercial products. The body of information about immunological features is rapidly expanding to further reinforce the contention that breast milk cannot be replaced by any artificial feeding.

The well-nourished mother, eating a nutritionally adequate diet, should encounter no difficulty satisfying the infant's nutritional needs. The quantity of human milk decreases in the poorly nourished mother. However, the nutrient composition remains relatively unaffected, except for fatty acid composition and vitamin content, which fluctuate with maternal diet (1).

The specific benefits of breast milk for the infant are as follows:

Protein – lactalbumin – The lower quantity of protein in human milk provides for a moderate rate of growth in which the baby doubles his birth weight in 150 days.

Human milk is composed of 60 per cent lactalbumin and 40 per cent casein. The larger percentage of lactalbumin in human milk differentiates it from cow or goat milk, and provides the following advantages for the infant:

- it forms a soft curd which is easily digested and absorbed.
- it is a more complete protein, yielding a higher percentage of essential amino acids.
- it is more completely utilized, creating fewer end-products of protein metabolism, thus causing less stress on the infant's kidneys (2).

Fat – Human milk fat is easily absorbed by the normal full term infant. The mechanism by which this absorption occurs is credited to the triglyceride arrangement of the fatty acids rather than as previously thought, to the percentage of individual fatty acids present (3).

This ability to readily absorb the fat of breast milk is advantageous since the high caloric needs of infancy are satisfied and a positive nitrogen balance is fostered, allowing the ingested protein to be used primarily for tissue building.

Ascorbic acid – vitamin C – Human milk can be considered an adequate source of vitamin C for the infant, if the nursing mother's daily food intake includes two servings of vitamin C rich foods. (4)

Immunity – The infant is in a dependent status at birth, and needs to acquire a host resistance to infection until his own immune system has matured. (5)

Colostrum, the yellowish secretion from the breast during the first few days after delivery, is believed to yield a high degree of passive immunity. The presence of the dominant antibody, secretory IgA, in colostrum and breast milk, makes the gastrointestinal tract more resistant to the invasion of enteropathic organisms, namely, bacteria and viruses. (6)

In addition to the protection from gastro-intestinal disorders, the incidence of respiratory infections, meningitis and gram negative sepsis also appear to be lower in the breast fed infant. (7, 8, 9)

Unmonitored volume—The volume of milk ingested from the breast is unknown to the mother. Therefore, the infant is able to develop a natural response to its feelings of satiety.

Hygienic food—Human milk is free of environmental contaminants, and thus eliminates the occurrence of intestinal upsets due to unsanitary handling of formulas and bottles.

Convenience—Human milk is readily available, completely prepared, and at the acceptable temperature. It also eliminates possible errors in formula preparation, which can be quite hazardous to the infant (see page 10).

While breast feeding has many benefits for both mother and child, it is still a very personal decision reached by the mother, in consultation with her physician. Every effort should be made to avoid feelings of guilt if it is not selected. The goals of initial infant feeding are to provide for the nutritional needs of the infant, and foster the development of a warm mother-child relationship. Either breast, or bottle feeding, can supply these goals. Support should be given for the method selected by the parents and the physician.

Physical or emotional reasons may make it advisable for a mother not to breast feed her infant. Some examples are

- Chronic illness of the mother.
- Occurrence of another pregnancy.
- Use of oral contraceptives.
- Mother's strong aversion to breastfeeding.
- Wishes of spouse and/or other family members.
- Local breast pathology (10).

Drug transmittal in human milk

Questions may arise about the use of drugs and chemical substances during lactation. Almost all such substances taken by the nursing mother will appear in her milk, but usually in insignificant amounts. The transport of the foreign substances from the plasma to milk is still poorly understood. The toxicity of all drugs is related to the body weight of the recipient. Therefore, the infant, because of its smaller body size, is at risk to smaller doses of some drugs

transmitted in breast milk. The criteria for evaluating a drug or chemical substance during lactation is its effect on milk production, and on the health of the infant (11).
Some commonly used drugs and chemical agents are:

Alcohol–moderate amounts (one to two cocktails) are not harmful to either the nursing mother or infant (12).

Nicotine–cigarette smoking may reduce the volume of milk excreted. In addition, trace amounts of nicotine from cigarette smoking are transmitted to the infant. It has not been established what are the long term effects of this small amount of chemical passed onto the infant through mother's milk. It is therefore advisable that the nursing mother quit or cut down on her smoking (11).

Caffeine–the concentration in coffee is probably too low to have any pharmacologic effect for the lactating woman or her baby (12).

Aspirin–a bleeding tendency can be produced by aspirin in the infant because it decreases the amount of prothrombin in the blood. The risk is minimal if the mother takes the aspirin just after nursing and the infant has adequate stores of vitamin K (12).

Laxatives–certain laxatives have been found in breast milk and have resulted in diarrhea for the infant. The physician's recommendation should be obtained before laxatives are used by the nursing mother (13).

Oral Contraceptives–it is generally felt that oral contraceptives (progestin-estrogen combinations) inhibit milk production. However, the effect can vary depending on how early the drug is initiated in the postpartum period, and its strength.

While rare, the side effect, gynecomastia, has been documented in a male infant. This aspect and long range aspects are still under investigation. Consultation and supervision by a physician is absolutely essential (11).

Insulin and Oral Hypoglycemic Agents–the diabetic mother who is well controlled on insulin should encounter little problem during lactation. When oral hypoglycemic agents are used, they may appear in the milk and possibly cause hypoglycemia in the infant. Caution and medical consultation is advised (12).

The following drugs are not recommended for use by lactating women:

antimetabolites, radioactive drugs, anticoagulants, tetracycline, iodides, ergot, atropine, metronidazole, dehydrotachysterol and thiouracil (14).

Note–When in doubt about any chemical or drug not mentioned above, the physician should be contacted.

Commercially prepared formula

Characteristics

The goal in formula research and preparation is to bring cow milk as close as possible to the currently known composition of mother's milk. Most commercially prepared formulas use skimmed cow milk as a base, since it can be easily modified to simulate human milk (15).

Formulas are modified to become adequate substitutes for human milk in satisfying the normal nutritional requirements for infants in one or more of the following ways:

- protein, treated to produce a softer more flocculent curd.
- butterfat, replaced with unsaturated fatty acids.
- calcium content, reduced by dilution.
- lactose, usually added to maintain caloric level.
- sodium content, reduced by dialyzing milk with a resin (16).

For specific nutritional information about commercial formulas, see Appendix A. Nutrient composition and ingredients in commercial formulas.

Common fortification features

Part of the modification procedure cow milk undergoes involves the addition of certain vitamins and minerals to make the product a more acceptable infant feeding. The Health Protection branch has regulations covering the nutritional composition and labelling of infant formulas. It is these regulations that manufacturers of infant formulas follow in producing their product. Some features of the regulations are:

Vitamin C–Because cow milk is a poor source of ascorbic acid, manufacturers now add this vitamin to the preparation in order to bring it closer in nature to the composition of human milk.

Vitamin D–Commercial formulas are also fortified with Vitamin D, eliminating the need for the infant to consume a supplement for this nutrient.

Iron–The regulations governing infant formulas state that *"infant formulas will contain a minimum of 0.15 mg of iron per 100 calories, an amount comparable to human milk."* Formulas containing more are required to carry the statement *"with additional iron"* (17).

Other vitamins and minerals–Other vitamins and minerals are added in accordance with the infant formula regulations from the Health Protection Branch.

Home prepared formula

Whole cow milk

Whole cow milk is an adequate milk feeding when modified by the mother. The protein, carbohydrate, and fat are adjusted so they more closely resemble the composition of human milk. Because other nutrients are not altered, it is necessary to provide the baby with a supplement of C and D, if milk is not already fortified.

Modification for the newborn includes dilution with water, and addition of some form of sugar. It is important to note that this home preparation should be sterilized for three valid reasons.

- It will destroy the bacteria to which babies are particularly susceptible.
- It will slightly denature the protein making it more digestible.
- It will help to guard against the gastrointestinal blood loss that may occur if non-heated cow milk protein is used (18).

Note

Overheating can result in an overconcentrated formula which is potentially hazardous to the infant. (see page 10)

Evaporated whole cow milk

An evaporated whole milk can also be modified to simulate human milk. This product is already supplemented with vitamins D and C making it unnecessary for baby to receive a supplement of this type. It is economical, readily available, sterile and can be stored, unopened, without refrigeration.

For directions on home formula preparation see Appendix B. Sample formulas for one day's supply.

Milk not recommended for formula preparation

Condensed milk is unsuitable because of its high sugar content.

Unmodified whole cow milk is unsuitable since the balance of protein, fat and carbohydrate is incorrect. The butterfat is not readily absorbed until about six months of age. Before that age, fecal fat losses would result in increased caloric needs for the infant if the unmodified milk were used. Therefore, unmodified whole milk should not be introduced to infants before six months of age (19).

Skim milk and two per cent are not recommended for use for the infant until after one year of age. At this point, their use in the diet is optional, and should only be considered if the infant's diet is adequate. (see pages 24-26)

Percentage of calories from protein, fat and carbohydrate (19).

		Type of milk		
	Desirable range	Human	Cow's (whole)	Cow's (skim)
Protein	7-16%	7	20	40
Fat	30-55%	55	50	3
Carbohydrate	35-65%	38	30	57

More detailed information on the problems associated with skim milk usage during infancy are provided in the section - Use of skim milk vs. whole milk.

Other concerns

Overconcentration of formulas

Overconcentration of infant formulas may lead to tragic consequences for the infant, including dehydration, renal failure, and gangrene (20).

Formulas can easily become overconcentrated by the following methods.

- Boiling the milk too long during sterilization and heating. (Add water to replace evaporation loss if it occurs)
- Improperly diluting commercial formula.
- Using undiluted evaporated milk as formula.
- Adding extra dry skim milk powder to regular formula.

It is important to stress the necessity of adhering to formula preparation directions exactly, for the hazards of a *richer milk* are not readily apparent to the public.

Recommended supplementation with milk feeding

Vitamin and mineral supplementation varies, depending on the type of feeding being given to the infant.

Vitamins—For the breast fed infant the only vitamin supplementation necessary is vitamin D. Although the infant can synthesize vitamin D in the presence of sunlight, the variable exposure of infants to sunlight in this climate, makes supplementation necessary. Human milk will supply adequate vitamin C, as long as the mother's intake of this vitamin is sufficient.

- When the infant is being fed a home prepared formula made from fresh fluid milk, a vitamin C source is necessary, usually in the form of apple juice or diluted orange juice. Vitamin D supplementation is unnecessary, because as of March 1, 1976, all milk in Canada must have vitamin D added.

- Commercially prepared formulas do not require any supplementation.
- Formula made from goat milk requires vitamin C, D and folacin supplementation.

Fluoride–In areas where the water supplies are not fluoridated, it is desirable to provide the infant with fluoride.

Iron–The Canadian Pediatric Society is currently recommending that all formula-fed term infants receive an exogenous source of iron no later than four to six months. Before this time, the iron status of the healthy term infant is not a concern.

The Dietary Standard for Canada indicates that while breast milk contains less than the 7 mg/day of iron recommended for infants, it is considered adequate because the iron is probably better utilized than iron from other sources (21).

When iron is introduced, the best dietary source is iron fortified cereal. The desirable amount is two portions daily.

Excessive ingestion of fresh cow's milk may contribute to iron deficiency, by increasing gastrointestional blood loss. Therefore, if used during the first six to twelve months of life, it should be boiled.

The following table will summarize the above information regarding nutrient supplementation with milk feeding.

Supplementation needed

Type of Milk	Vitamins			Fluoride	Iron	Other
	A	C	D			
Human			†	*	**	
Commercial formula				*		
Whole cow milk formula		†		*	**	
Evaporated milk formula				*	**	
Goat milk formula		†	†	*	**	folic acid

*Desirable where water supply is not fluoridated.
**See discussion above.
†Supplement needed.

Solid foods

Introduction

Solid foods are the infant's next milestone. The decisions of what foods to feed the infant, and when to introduce them, should be guided by the infant's physiological development.

The development of the muscles in an infant's mouth is a major influence on his feeding, for it is not until the third or fourth month that he is capable of transferring food to the back of his mouth by tongue action.

An infant's first teeth develop at six to eight months. This is a good indication that he is ready to progress to more solid food (dry bread, mashed family vegetables, etc.). Teething biscuits are not recommended, since their sugar content can contribute to early dental decay. A teething ring is a good substitute. Rhythmic biting motions begin at seven-nine months. By ten-twelve months the infant should be offered *chewy* foods to encourage development of hand-to-mouth co-ordination and proper chewing. A word of caution here. Many professionals and parents fear the infant will choke. Avoid giving foods from which small chunks can easily be broken (e.g. carrot sticks). Feed instead, whole carrots that are good for gnawing, bananas, orange sections, apple sections, toast, etc. Allowing the child to eat food that could potentially cause choking while playing or running around is a practice to be discouraged.

Enzymes necessary for the digestion of nutrients other than those in milk, develop in definite stages. Although infants seem to tolerate cereals at an early age, research suggests that digestion of starches is incomplete in the young infant (22).

Therefore, the infant is physiologically unready for solid food before three or four months of age. In addition to physiological unreadiness, solid food before this age is discouraged for the following reasons.

- Solids are filling, so milk intake will likely decrease when solids are introduced. This is undesirable, because the infant needs the nutrients and fluid in the combination milk provides.
- Potential food allergy may surface if solids are introduced before the digestive system is ready to handle them.
- The trend toward early introduction of solid foods may lead to obesity in infants. There is concern about obesity in infants since it appears to be persistent in later life. This subject is discussed in greater detail on page 22. (23).

Certain situations may mislead the parent into thinking that the infant requires solid foods before three months of age. Among these are the following.

- Around the second or third month, many infants will exhibit a temporary increase in appetite, and will not be satisfied with their usual quantity of milk. This behavior is related to a temporary, intensive growth spurt. Simply provide the additional milk feeding to satisfy this transient hunger. Within a few days the infant should return to his usual feeding pattern. (24)
- Many parents also argue that feeding solids, especially cereal, causes the very young infant to sleep through the night. This theory has been unsubstantiated; possibly early feeding of solids makes the mother feel better, rather than producing a change in the infant's behaviour. Parents may also consider eating solids an accomplishment; a mark of progress, and thus compete to have their childrn eat solid food as early as do other infants.

A general feeding guide for the introduction of solid foods appears on the next page. **Always remember that every child is an individual, and the exact age will vary slightly.**

Suggested guide for introduction of solid foods

Approximate age in months	Food	Reason for introduction
1-3	human milk or formula (fortified with vitamins C & D)	Meets the infant's nutritive needs until three months of age.
3-4	iron enriched infant cereal	Provides a dietary source of iron. The infant's iron reserves last only three months.
4-5	pureed vegetables pureed fruits	Provides dietary sources of vitamins, minerals, calories. Introduces new food flavours. Starts setting basis for good eating habits. Introduce vegetables first to reduce the chance of developing a sweet tooth.
6-7	dried bread	Encourages chewing when teeth erupt.
	whole undiluted milk	Digestive system ready to handle butterfat.
6-8	pureed meat and alternates (beans, peas, lentils, etc.) egg yolks cottage cheese	Provides additional protein, vitamins, iron for rapid growth. Egg white not offered until 12 months to avoid precipitation of allergy.
8	mashed family vegetables other mild cheese	Introduces texture of foods other than pureed.
10	chewy finger foods	Encourages chewing, co-ordination, independence.

Cereals are the first solid food to be introduced to an infant. It is customary to introduce rice cereal first, since it is least likely to cause an allergy (wheat or oats tend to be quite allergenic). Mixed cereals (usually made from wheat, oats and corn) are discouraged until each cereal has been separately introduced.

There are some infant cereals on the market that are referred to as high protein cereals. These are usually made from soya flour and may be as high as 30 per cent protein. Fomon recommends that for full term infants

- 7-16 per cent of calories be derived from protein,
- 30-55 per cent of calories be derived from fat, and the remainder of calories be derived from carbohydrate. (19)

An intake of protein accounting for more than 16 per cent of calories may not be harmful, but certainly constitutes a metabolically and economically inefficient manner of providing the infant with calories.

New foods should be introduced one at a time, several days apart so that if the infant has an intolerance to the new food it will be easy to identify which food is causing it.

Very small amounts of a new food (a teaspoon or less) should be used at first, increasing gradually.

An infant should never be forced to eat a new food if he refuses it. The refused food should be tried again, a week or so later.

An infant should be introduced to new foods when he is feeling fit and happy. He will likely refuse a new food if he is cranky, not because he does not like the taste, but because he is out of sorts.

Seasoning—Butter, margarine, salt or sweetening (sugar, honey or molasses) should **never** be added to an infant's food. Adding these things make the food suit adult tastes, not the taste of the infant.

Combination dinners—It is better for an infant to learn individual flavours of foods, since this is how he will eat them later, so combination dinners (whether they are commercially prepared or recipes prepared at home) are **not recommended** for daily use.

It is also more difficult to determine the source of an allergic reaction if it occurs when a combination dinner is fed. In the case of an infant with a family history of allergy, it is recommended that highly allergenic foods be avoided for the first six months of life.

Overeating—Some people have suggested that an infant will instinctively choose a well-balanced diet. This is **not** true. However, an infant does know how much he needs. Coaxing him to finish off his bottle, or clean up his plate, may lead to a lifetime of overeating.

The infant should be served a **variety** of foods, even those the parents do not like. The parents should be careful not to display their dislikes, and thus influence the infant's acceptance.

Decreasing appetite—About one year of age the infant's growth will slow down. Consequently, his appetite will probably decrease. This is normal. The infant does not need as much if growing more slowly. Parents should avoid the urge to try to get the child to eat more than it wants.

At this time, milk should be offered at the end of the infant's meal so that it does not decrease its appetite for the rest of the food.

Snacking—Infants and young children have small stomachs so therefore it may not only be necessary to feed them small amounts of food at one time, but to feed them more frequently.

Let the infant's appetite be the guide. Snacks as well as meals should contribute nutrients.

Candies, sweets, and soft drinks are damaging to newly erupted teeth and can decrease appetite for the nutritious food needed for growth. If the infant hasn't tasted them, they won't be missed.

Commercially prepared baby food

Pros

- Sanitary
- Convenient
- Available in a wide variety
- Processed when foods are at their peak of quality
- Processed in a way as to retain maximum nutrient value.

Cons

Some criticisms of commercially prepared baby food follow.

- Many of these products have appreciable amounts of sugar added (e.g. fruits, juices, creamed vegetables, desserts, puddings). This is undesirable because sugar contributes to dental decay, and early consumption of sweet foods may predispose the child to a preference for sweets in later life.
- Samples of strained meats (liver and lamb) from Canada have been

analyzed, and discovered to have a much higher fat content than corresponding U.S. products, and contain proportionately lower content of other nutrients than is desirable (25).

- The many *dinners* available encourage mothers to feed mixed dishes rather than introducing the child to individual foods, and their flavours.

The desserts and puddings category has increased more than any other in recent years. This is undesirable since these desserts primarily contain sugar, and therefore do not contribute to the infant's nutrient intake.

An interesting observation is that commercial baby food companies appear to look upon the mother as the consumer, and design their products to appeal to her tastes and preferences, rather than entirely for the infant's nutritive benefit.

Therefore, the following recommendations apply to the use of prepared baby foods.

Avoid any that list sugar as a major ingredient (e.g. desserts, puddings).

Avoid special products for infants when the one used for the family would suffice (e.g. frozen unsweetened concentrated fruit juices).

Avoid unnecessary products (e.g. use plain vegetables rather than creamed vegetables).

Avoid dinners—buy plain meats, vegetables and fruit.

Conclusion

Commercially prepared baby foods do have advantages, and if chosen wisely, are quite acceptable in infant feedings.

Home prepared baby food

Pros

A great mistrust of large commercial companies, and a *back to basics* movement, has resulted in an increasing number of mothers preparing their own baby food.

Among the advantages the mother can provide are the following:

- Good nutrition
- Low cost
- Few additives (such as salt and sugar)
- Home preparation may stimulate the whole family to improve the variety of foods consumed.

Cons

Conversly, home prepared baby foods may be of inferior quality, unless the mother, as processor, ensures

- Maximum nutrients are retained, by using proper cooking methods
- Optimum processing and storage
- Good sanitation
- Wide variety of foods

Therefore, disadvantages of home prepared baby foods are based on variables that can be altered through appropriate education of the mother. At present, there seems to be a lack of reliable literature in popular

bookstores for preparing baby food at home. A brief outline for home preparation of baby food follows.

Equipment

A blender is useful, but not essential. However, the cost of commercial baby food has risen sharply in recent times, so that it is now a money-saving venture to buy a blender strictly for the preparation of baby food at home. If a blender is not available, a food grinder and/or strainer can be used to achieve the desired effect (25).

What to feed

Probably the easiest foods to use are family foods. These should be *plainly prepared* i.e. no fried, spicy, fatty foods. The infant's portion should be removed before any seasonings are added such as butter, margarine, salt, or sweetening (honey, sugar, molasses).

Vegetables and fruit

Vegetables

Use fresh, frozen, dried.

Suggested choices are green or yellow beans, broccoli, turnip, asparagus, squash, peas, and corn.

Fruit

Use fresh, frozen, dried.

Suggested choices are apricots, peaches, apples, pears, bananas.

Avoid fruit with large amounts of fibre or seeds such as strawberries, raspberries, pineapple.

Preparation tips

All fresh fruits and vegetables should be cooked before blending.

When blending fruit extra liquid is usually unnecessary.

Do not use home prepared beets, carrots or spinach before the infant is six months of age. (see page 22.)

Meat and alternates

Cut meat into small pieces to decrease blending time.

Choose lean meat that has been stewed, braised, boiled or roasted.

Suggested choices are pork, beef, veal, chicken, turkey, lamb, liver, ham (the last on a limited basis only).

Meat alternates can also be used, e.g. dried beans, peas, lentils, cottage cheese, egg yolks. For blending the beans, peas and lentils use the processing instructions given for vegetables.

Cooked egg yolk and cottage cheese should simply be mashed. If this seems too dry a little milk could be added until the desired consistency is reached.

Other types of mild cheese should be introduced when the infant can handle the texture without modification.

Areas of question

With the increasing popularity of home preparation of baby foods, infants are now being given foods which have not traditionally been used in infant feeding (e.g. canned vegetables and fruit). No solid research has yet been done on the problems which could be associated with these practices.

Among specific areas in question are the following.

Salt content

At present, commercially canned *adult* vegetables are much higher in salt content than the commercially prepared infant vegetables. Recently, much attention has been directed at the high sodium content of commercially prepared infant foods. The companies subsequently reduced the quantities of salt used. While the long term effects of a high sodium intake are still uncertain, one questions the safety of feeding only pureed canned vegetables to the infant.

Lead content

Traditionally, baby foods have been packaged in glass containers. The use of tinned products for pureed baby foods, raises questions. The amount of lead transferred from can to food is not known. Also, little information exists about lead metabolism in infants.

There is a great need for research to clarify these points before any conclusive statements can be made, either for or against, tinned foods. The best advice to parents at this time is that canned foods, intended for adults, should **not** be used to prepare pureed baby foods, because of the salt and possibly the lead content.

Cooking methods

For recommended cooking techniques, contact your provincial Ministry of Agriculture for free booklets, or refer to a good basic cookbook.

Processing

Use the operating procedures recommended by the blender manufacturer. Excess blending causes destruction of nutrients.

Do not process mixtures too long since the blender does its task in seconds

Use small quantities of no more than ¾ cup at one time. This gives a uniform product with a minimum of blending

Cut firm food into pieces no longer than one inch to decrease blending time

Remove a small amount and rub it between your fingers to test for smoothness.

Food	Place in blender container* and cover	Blend	Yield
Fruits	⅓-½ cup cooked or canned fruit, 2 tsp. fruit juice or water if necessary.	15-45 seconds	⅓-½ cup
Vegetables	¾ cup cooked or canned vegetables, 3-4 tbsp. vegetable liquid or water	1-2 minutes	½-¾ cup
Meat	½ cup cubed meat, 3-4 tbsp. water, milk, or other liquid	process until smooth	⅓-½ cup

*It may be more convenient to purchase small sized blender containers that are designed especially for making baby food.

When a blender is not available, fruit and vegetables can be strained to achieve the desired consistency. Strained meats are difficult to prepare at home without a blender.

Storage and sanitation

When preparing food for an infant, it is important to follow fairly strict sanitary techniques. Many of these suggestions apply to commercially prepared baby food as well.

Ensure your blender and storage jars are very clean. If a strainer is used, be sure all food particles are washed out of the holes, and rinse with boiling water. In fact, rinsing all equipment with boiling water before using, is a good practice, and should be strongly encouraged.

Use food immediately, or put it directly into the refrigerator after processing.

The infant should be fed from a serving dish, not from the storage jar, and the storage jar should be out of the refrigerator only long enough to remove each serving. Leaving the storage jar at room temperature, or heating the food in the storage jar, increases the risk of contamination, and delays the chilling time.

Food should be prepared in small enough portions to be used up within **three** days. If freezing foods, the thawed portions should be small enough to be used in a day or two.

The storage container should be covered during refrigeration. This reduces contamination with airborn bacteria, yeast, and molds, which cause spoilage. It protects the foods from drying, and from the odours of other foods in the refrigerator. It also helps prevent loss of certain nutrients.

Containers may be covered with aluminum foil, plastic film, or wax paper.

Freezing

Pour into ice cube containers, cover and freeze. When frozen solid, store in plastic freezer bags. Make sure all air is out of the bags to prevent vitamin destruction. Each cube is a good serving size. Thaw and heat cubes in double boiler, or custard cup in hot water. Do not keep frozen foods for longer than one month.

Potential hazards of nitrates

Nitrates in food have been mentioned in both the professional and popular literature as being potentially hazardous to health. There are two different mechanisms by which nitrates are thought to be harmful. 1) through the formation of a methemoglobinemia, and/or 2) through the generation of nitrosamines. This detailed explanation has been included to assist the health professional in clarifying some of the confusion and concern surrounding these relatively rare conditions.

Methemoglobinemia

Background–The nitrite ion has the ability to oxidize the ferrous iron of hemoglobin to ferric iron, resulting in the formation of methemoglobin which is incapable of carrying oxygen. As the concentration of methemoglobin rises in the blood, cyanosis will result. Death from asphyxia can occur when methemoglobin exceeds 70 per cent of hemoglobin in blood. Methemoglobinemia develops more readily in infants than in older children, or adults (26).

Conditions favouring methemoglobin development–Nitrates are normally metabolized, and excreted from the body, without ill effect. Nitrates may be converted to nitrites under special conditions.

- pH of gastric juice above 4.0
- presence of nitrate reducing bacteria in upper gastrointestinal tract (26).

Implications–The development of methemoglobinemia has not been linked with the use of any commercially prepared baby foods.

Isolated cases of methemoglobinemia have been reported in infants two to ten months of age after eating home prepared spinach. Testing of the spinach revealed a very high nitrite content, indicating the product became toxic after being prepared.

Possible unsanitary preparation and storage methods were suspected to have contributed to the rapid conversion of the naturally occurring nitrate to the toxic nitrite (26).

The use of home prepared carrot juice has also resulted in a documented case of methemoglobinemia. Beets also contain high levels of nitrate, and are not recommended for infants (27).

Until more concrete information is available, the potential hazard of methemoglobinemia suggests a cautious approach. Thus, home prepared carrots, beets and spinach **are not recommended** in the first six months of life.

Nitrosamines

Background – It has been observed that eating foods containing both nitrites and amines, can result in the formation of nitrosamines. When tested in animals, the nitrosamines have been shown to have carcinogenic potential.

Implications – While no documented evidence is available for carcinogenic growths in humans resulting from nitrosamines, the possible hazard does exist. A cautious approach of limiting the sources and intake of nitrates and nitrites in infant foods seems advisable. Thus ham and cured meats **should be limited** during the first year (28).

The difficulties encountered in treating the common diseases of lifestyle such as obesity, heart disease and dental caries are well-known. A preventive approach is the only reasonable long-term solution.

While the increasing interest in preventive measures is encouraging to public health professionals, some present theories and practices suggested for implementation during infancy appear questionable, for they may interfere with normal growth and development. Because of the current popularity, growth and development of some of these practices, they are examined here.

Infantile obesity

Prevention

Obesity in infants can be prevented by instilling good food habits which promote normal weight gain. It is essential that health professionals provide sound guidance about infant feeding practices including:

- the type of milk and solid feedings to offer
- when these foods should be introduced
- ad libitum feeding
- how often feedings should occur

Inadequate knowledge results in parents basing the feeding of their children on custom, popular thinking, and social pressures.

Definition

There are many simple *rules of thumb* which have developed to help health professionals decide if obesity is present in infancy. The most commonly used method is rate of weight gain, where an infant is normally expected to double the birthweight by four to six months and triple it by one year. The main limitation of this method is the fact that it is so arbitrary. A more accurate method is measurement of fat-fold thickness. However, much practice with calipers is necessary before consistent results can be obtained. Therefore, a chart such as that developed by Fomon (Appendix D) which compares length and weight, seems to be a more accurate, practical measure. However, this is still not a precise, conclusive definition of obesity.

Adulthood

Research does not provide conclusive evidence that the obese infant becomes an obese adult. However, there is a general agreement that fat babies have a high probability of becoming fat children. Many theories to explain this phenomenon have been proposed, a popular one being the fat cell theory. This theory has been questioned recently, because of the limitations encountered in counting the number of fat cells. (29)

Feeding practices linked to infantile obesity

Encouraging the infant to empty bottle—The infant has accurate physiological methods of determining how much food is needed. This fact is not recognized by many parents. The *finish it off* attitude is particularly prevalent in bottle-fed infants. A higher rate of weight gain for a specific length has been observed in bottle-fed infants, and has been attributed to increased calorie intake. (30)

Early introduction of solid foods—Current practice encourages introduction of cereals and strained foods around six weeks of age. This practice may cause an increase in calorie intake in two ways:

- caloric density of some infant foods is higher than an equal quantity of milk.
- if solid foods are fed in addition to the usual volume of milk, calorie intake will be higher.

Non-nutritional contributing factors—Discrimination between the infant's nutritional, physiological and emotional needs is essential. The infant cries for many reasons other than hunger (e.g. thirst, a wet diaper or discomfort in general). If food is offered when the infant cries for reasons other than hunger, overfeeding is likely to occur. Also, in this case, the infant is being taught to

substitute food for more appropriate solutions to many of life's problems.

Mothers of infants experience subtle social and cultural pressures with regard to feeding their babies. Weight gain is interpreted to mean the infant is thriving. The earlier the infant accepts solid foods, and empties a complete bottle is viewed as an accomplishment. Mothers are conditioned to desire these goals for their infants, and to measure their competence in rearing children by how fast their infants reach these milestones. In these situations, the infant becomes conditioned to consume more than internal cues dictate.

The passive infant who sleeps for long periods, and takes large quantities of food is considered the ideal infant. However, the need for activity exists even among the very young. Some infants may need more active intervention and stimulation from mother to start practicing the usual exploratory movements of infants. Without the sessions of grasping, kicking, and squirming movements which expend energy, the infant may be further predisposed to developing obesity during infancy.

The following sugestions will foster physical activity in infancy. (32)

Encourage mother to increase her interaction with the infant.

Increase the amount of stimulation the infant receives daily.

Accept the fact that the infant can be awake at times other than while being fed or hungry.

Skim milk versus whole milk

Recently there has been some emphasis placed on the use of skim milk when the infant is ready to receive unmodified milk (six months of age). This is also a time when solid foods should have become a regular part of the diet. It is believed this practice of introducing skim milk has increased in prevalence in an effort to prevent the occurrence of infantile obesity, or to treat the condition of obesity.

However, the available literature provides enough evidence to discourage this practice, for children, during the first year of life. Skim milk is an undesirable choice, since it would result in inadequate calorie and fat intakes, inadequate intake of essential fatty acids, and excessive intakes of protein and lactose. Elaboration of these four points is outlined in the following.

Inadequate calories and fat

Total calorie intake plus fat intake, are likely to be undesirably low, creating a feeding that has a low satiety value. The infant normally relies on the fat to furnish calories. When it is absent, there is a strong possibility that the child will begin to utilize its own body stores of fat to supply the energy it needs. Fomon states, "One may wonder, for example, whether an infant required to mobilize stores of body fat in order to supply energy requirements is able, simultaneously, to synthesize the lipids essential for the myelination of the nervous system." (33)

An unpublished study conducted on infants 112 to 168 days of age who were fed a skim milk type of formula, produced more evidence against its use for the infant. When skinfolds were measured over an eight week period a decrease in thickness was noted. This indicated the infants were utilizing their fat stores which is an undesirable occurrence at this early age. (34)

These skim milk fed infants consumed more formula (volume) while getting fewer calories than the control group. Fomon has speculated that, "It seems possible that consumption of large volumes of food for a prolonged interval during infancy might establish a habit of overeating that would persist beyond infancy." Thus when skim milk is offered the *overeating* which results is necessary to maintain normal growth but later it may result in a habit fostering obesity. (32)

Inadequate essential fatty acids

Whole milk provides 35-55 per cent calories from fat while skim provides only 3 per cent calories from fat. With this exceedingly low intake of fat, the essential fatty acids required during infancy are likely to be deficient.

Excessive Protein

An infant's diet should provide approximately 7-16 per cent of calories from protein, yet use of skim milk results in about 40 per cent of calories from protein. The immature kidney may have difficulty handling the greater solute load created by this excessive intake of protein.

Lactose overload

Use of skim milk creates a diet where the infant receives a higher intake of carbohydrate than is desirable. The resultant increased lactose load might be excessive enough to produce diarrhea in some infants. (32)

Use of two per cent milk

One may hypothesize that the two per cent milk feeding would also be undesirable for similar reasons. Even though the conditions previously described might not be as severe, problems like low satiety value would still be present. Also, there is no evidence yet to suggest that it would be advantageous for the infant to be receiving two per cent instead of whole milk. Therefore, it is advisable to continue use of whole milk for infants up to one year of age.

Cholesterol control

Prevention has become a key word when discussing atherosclerotic diseases for the adult population. One form of prevention is dietary modifications of total fat, type of fat and cholesterol intake. However, the committee on nutrition of the American Academy of Pediatrics specifically recommended against dietary intervention for all children. Skim milk, because it leads to inadequate calories or essential fatty acids is not appropriate for children other than those with hereditary hyperlipoproteinemia. Also, there is no evidence that normolipidemic children will benefit from similar therapy. (35)

Dental caries

Nursing bottle syndrome is a dental condition frequently seen in young children who habitually receive, as a bedtime pacifier, a nursing bottle of water sweetened with sugar, syrup or honey, sweetened milk or fruit juice or a soother dipped in syrup. During the period when the child actively sucks at the bottle, the salivary flow is increased which helps to buffer the plaque acids. However, as the child falls asleep, the salivary flow diminishes and the teeth are continuously bathed throughout the night in the sweetened substances. This leads to the characteristic rampant decay of all the upper teeth and, occasionally, the lower back teeth. The lower front teeth are never affected as they are protected by the tongue. (36)

As well as being unsightly, this condition is undesirable since it negatively affects chewing abilities, speech habits, and emotional and social development. It will also result in the need for restoration of the teeth that is both painful and costly.

It is recommended that

Plain milk, or fluoridated water be used at the bedtime feeding of young children whose teeth have erupted. (35)

Sweetened beverages, such as milk with added sugar, artificially flavoured fruit drinks, sweetened fruit juices or water, be discouraged. (36)

Parents receive instruction during prenatal classes on dental care for infants. (36)

The use of fluoride supplements be emphasized in areas where local water supplies are not fluoridated.

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Appendix A

Nutrient composition and ingredients in commercial formulas*

Formula	Percentage Wt Vol			mEq/liter		mg/liter			Vitamin supplement	Kcal 30 ml normal dilution	Composition of formula			Availability	
	Protein	Fat	CHO	Na	K	Ca	P	Fe			Protein	Fat	CHO	Liquid	Powder
Breast milk	1.1	4.5	6.8	7	13	340	140	trace	–	22	Human milk	Human milk fat	Lactose	X	
Cow's milk															
Whole	3.5	3.5	4.9	22	37	1180	930	trace	D only	20	Cow's milk	Butter fat	Lactose	X	X
2%	3.7	2.0	4.9	24	39	1199	1090	trace	D only	18	Cow's milk	Butter fat	Lactose	X	
Skim	3.6	0.1	5.1	23	37	1210	950	trace	D only	10	Cow's milk	Butter fat	Lactose	X	X
Evaporated milk															
Whole	3.4	3.9	4.8	27	41	1345	1095	trace	C&D only	21	Cow's milk	Butter fat	Lactose	X	
2%	3.5	2.0	4.8	27	41	1345	1095	trace	C&D only	15	Cow's milk	Butter fat	Lactose	X	
Regular Prepared Formulae															
Enfalac	1.5	3.7	7.0	11	19	650	500	2.1	+	20	Cow's milk	Soy, corn, coconut oil	Lactose	X	X
Enfalac with iron	1.5	3.7	7.0	11	19	650	500	8.5	+	20	Cow's milk	Soy, corn coconut oil	Lactose	X	X
SMA	1.5	3.6	7.2	6.5	14.3	420	330	12.7	+	20	Electrodialized whey	Oleo soy corn, coconut oil	Lactose	X	X
Similac	1.7	3.4	6.7	13	26	700	500	trace	+	19	Cow's milk	Corn, olive coconut oil	Lactose	X	
Similac with iron	1.7	3.4	6.7	13	26	700	500	12.0	+	19	Cow's milk	Corn, olive coconut oil	Lactose	·	
Similac PM 60/40	1.5	3.4	7.2	6.5	14.1	330	170	trace	+	20	Electrodialized	Corn, olive	Lactose		·

formulae															
Soyalac	2.0	4.0	5.9	14.6	NA	435	381	11.0	-	20	Soybean	Soy oil	Sucrose, dextrose dextrin maltose	X	X
Prosobee	2.5	3.4	6.8	22	23	950	12.4		+	20	Soy protein isolate	Soy oil	Sucrose, dextrose maltose dextrins	X	
Isomil	2.0	3.6	6.8	13	18	700	500	12.0	+	20	Soy protein isolate	Corn, coconut oil	Sucrose, dextrose maltose dextrins	X	
CHO-Free	1.8	3.5	6.4	15	23	850	650	8.5	+	19	Soy protein isolate	Soy oil	Added as required, figures for 6 per cent	X	
HSC lambs base	1.7	3.4	7.4	6.3	8	10	172	3.0	+	20	Strained lamb	Lamb fat, corn oil	Added as required figures for 6 per cent	X	
Therapeutic formulae															
Lofenalac	2.2	2.7	8.5	26	38	1000	700	17	+	20	Casein hydrolsate	Corn oil	Maltose, dextrins sucrose		X
Nutramigen	2.2	2.6	8.5	17	26	1000	700	10	+	20	Casein hydrolsate	Corn oil	Sucrose, dextrins		X
Portagen	2.3	MCT2.8 LCT0.4	7.5	18	26	679	539	12		20	Sodium caseinate	Fractionated coconut oil (MCT), corn oil	Sucrose dextrins maltose		X
Progestimil	2.0	MCT2.2 LCT0.4	8.0	16.7	22	867	675	12	+	18	Casein hydrolysate	Fractionated coconut oil corn oil	Glucose, dextrins		X

(+) The vitamin supplements are vitamins A, D, C, E, B complex, B12, pyridoxine and panatothenic acid
(2) NA – not available
(3) Composition of formula is subject to frequent change For further information get in touch with Hospital for Sick Children, Clinical Investigation Unit
(4) Lamb base formula can be prepared at home – pureed lamb 3 jars, corn oil – 2½ tbsp., dextrose – 7 tsp., add water to make 1200 ml
(*) Hospital for Sick Children, Clinical Investigation Unit (December 1975)

Appendix B

Sample formulas for a one day supply

Age of baby	One–two weeks	Three weeks–two months	Two–three months
Total amount	18 ounces	24 ounces	30 ounces
Fresh whole milk*	12 ounces	18 ounces	24 ounces
water	6 ounces	6 ounces	6 ounces
sugar	2 tablespoons	2 tablespoons	2 tablespoons
Evaporated milk	6 ounces	9 ounces	12 ounces
water	12 ounces	15 ounces	18 ounces
sugar	2 tablespoons	2 tablespoons	2 tablespoons
Number of bottles	8 of 2¼ ounces or 6 of 3 ounces	6 of 4 ounces or 5 of 5 ounces	5 of 6 ounces or 4 of 7½ ounces

(From: Canadian Mother and Child–Department of National Health and Welfare, Canada, 1973).

*It is strongly recommended that the whole milk be heat treated i.e. through aseptic or terminal sterilization, to produce a safe formula for the infant.

Appendix C

The following meal pattern is meant as a **guide only.** Let the amounts suggested serve as such, but let your infant decide whether or not he wants all of it. Some babies are much hungrier than others, and may need a bit more.

Babies get thirsty, so it is desirable to give them water between meals. Do not add sugar to the water – your baby will readily accept plain water and the sugar would only contribute to early tooth decay.

There is no specific recommendation for texture of the meat, vegetables and fruit. Start out with strained (pureed) foods and progress as soon as the baby appears able to handle coarser textures. Once the infant starts getting teeth it is ready to move to *chewier* foods.

Snacks such as juice, milk, dry toast and plain biscuits may be given between meals if the child seems to be hungry. To prevent the possibility of choking, snacks should be given with the child sitting quiety, not while he is playing or running around.

Sample meal pattern for infant feeding

Feeding	Three months	Six months	Nine months
1	5-6 oz. milk (breast or formula)	6-8 oz. milk	
2	1-2 tbsp. infant cereal made with milk 5-6 oz. milk (breast or formula)	2 oz. juice (diluted 2:1) 4-6 tbsp. infant cereal made with milk 4-6 oz. milk	2-4 oz. juice (undiluted) 4-6 tbsp. infant cereal made with milk 1 tbsp. meat or alternates 6-8 oz. milk
3	5-6 oz. milk (breast or formula)	1-2 tsp. meat or alternates 2-4 tbsp. vegetables 6-8 oz. milk	2-4 tbsp. meat or alternates 2-4 tbsp. vegetables 2-4 tbsp. fruit 6-8 oz. milk
4	1-2 tbsp. infant cereal made with milk 5-6 oz. milk (breast or formula)	4-6 tbsp. infant cereal made with milk 2-4 tbsp. fruit 6-8 oz. milk	4-6 tbsp. infant cereal made with milk 2-4 tbsp. fruit 6-8 oz. milk
5	5-6 oz. milk (breast or formula) (discontinue when infant is sleeping through the night)		

Appendix D

Tentative definition of obesity

Age (months)	Males		Females	
	Length (cm) less than	Weight (kg) more than	Length (cm) less than	Weight (kg) more than
One	51.8	4.2	51.5	4.0
	53.0	4.5	52.2	4.3
	54.2	4.7	53.5	4.6
	55.2	5.1	54.6	4.8
Three	58.0	6.0	57.1	5.6
	59.2	6.4	58.0	5.9
	60.2	6.9	59.2	6.2
	61.5	7.3	60.2	6.6
Six	65.6	7.7	63.3	7.5
	66.5	8.2	65.2	8.0
	67.8	9.0	66.3	8.4
	69.2	9.6	67.8	8.9
Nine	70.0	9.1	68.2	8.9
	70.9	9.7	69.5	9.4
	72.3	10.7	71.1	9.9
	73.6	11.2	73.1	10.4
Twelve	73.6	10.2	72.5	9.9
	74.7	10.9	73.2	10.5
	76.4	11.6	75.1	11.1
	78.0	12.5	76.9	11.6
Eighteen	80.0	11.6	78.7	11.1
	81.7	12.6	80.2	11.8
	83.2	13.3	82.0	12.7
	85.3	14.4	84.2	13.2
Twenty-four	85.0	12.8	84.2	12.3
	87.3	13.9	85.8	13.1
	88.8	14.5	87.5	14.2
	90.9	16.0	90.3	14.9
Thirty-six	93.4	14.8	92.1	14.3
	95.3	15.7	94.2	15.3
	97.3	16.8	96.2	17.0
	100.6	18.6	99.0	17.7

*The table is based on data of Fomon et al. (1970, 1973) for ages one and three months, and on the data of Karlberg et al. (1968) for subsequent ages. At each age, the values for length for each sex are the 10th, 25th, 50th and 75th percentiles, while the values for weight are the 50th, 75th and 90th percentiles, and the mean plus two standard deviations.

(From: Infant Nutrition–Fomon–2nd Edition–reprinted with permission of publisher and author.)

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Thank you for your assistance.

Please fold and tape or staple the questionnaire so that the return address is showing.

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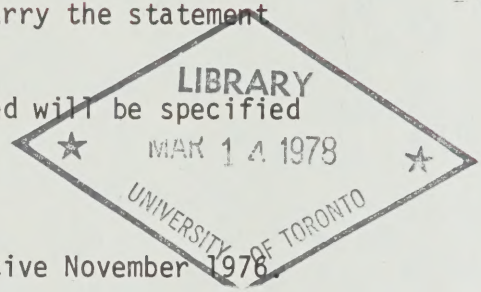
CORRECTIONS

Current Issues in Infant Feeding - 1977

(1) Pg. 8, 2nd column under "Iron"

The sentence "Formulas containing more are required to carry the statement 'with additional iron'" should be replaced with:

"Some formulas may exceed this minimum. The quantity used will be specified in the ingredient listing (17)."



(2) Pg. 28. Reference 17 should now read:

Food and Drugs Act and Regulations. Division 25. Effective November 1978.

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